Appendix C. Record Types (DRAFT revision, 11 July 2003)

This appendix outlines three different IMMA record types assembled from the fields to be agreed internationally for IMMA (Appendix D), plus nationally defined fields. The IMMA core (Table C0) forms the common front-end for all record types. By itself, the core forms a useful abbreviated record type incorporating many of the most commonly used data elements in standardized form. The core is divided into location and regular sections. Concatenating one or more "attachments" (attm) after the core will create extended records. So far, the following attms have been proposed:

Table C1: I-COADS attm
Table C2: IMMT-2/FM13 attm
Table C3: Model quality control attm
Table C4: Ship metadata attm
Table C5: Historical attm
Table C6: Supplemental data attm

The following record types (and selected lengths in bytes) have been proposed (Table numbers are used to indicate the corresponding attm):

- core record:
  core (108 characters)
- VOSClim record:
  core + C1 + C2 + C3 + C6 (315 characters, before C6)
- historical record:
  core + C5 + C6

The ship metadata attm is outlined in preliminary form, and currently is unused among the defined record types. Inclusion of the attm count (*ATTC*) field in the core, and of the attm ID (*ATTI*) and attm data length (*ATTL*) fields at the beginning of each attm, enable computer parsing of the records. Thus additional variations on these basic record types could be implemented by inclusion or omission of attms, and new attms can be defined in the future as needed for new data or metadata requirements.

Table C0. IMMA core. The columns in this table contain the following information ("to be decided" is indicated by *tbd*):

1: "D" is listed if the field configuration is discussed in Appendix D (proposed for international agreement); "C" if the field configuration is defined for I-COADS (e.g., in LMR documentation); "UK" if the field is defined by the UK; or blank (fields to be described nationally). "D = C" is listed if the I-COADS configuration is adopted provisionally, pending international standardization.
2: The projected length (Len.) in characters (i.e., bytes).
3-4: Proposed abbreviation (Abbr.) for each field, and a brief element description.
5-6: For fields with a tentative numeric range, the minimum (Min.) and maximum (Max.) are indicated. In other cases the range and configuration are listed as: "a" for alphabetic (A-Z), "b" for alphanumeric (0-Z), "c" for alphanumeric plus other characters, or "u" for undecided form (only for fields that are currently unused).
7: Units of data and related WMO codes. The information in parentheses relates the proposed field to a field from Appendix B, Table B1 (if applicable): WMO Code symbolic letters are listed, or "•" followed by a field number from Table B1 in the absence of symbolic letters. This information is prefixed by "□" if the field is proposed for extension in range or modification in form from the presently defined WMO representation.

Location section (45 characters)⊡

Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D	4	*YR*	year UTC	1600	2024	(AAAA)
D	2	*MO*	month UTC	1	12	(MM)
D	2	*DY*	day UTC	1	31	(YY)
D = C	4	*HR*	hour UTC	0	23.99	0.01 hour (□ GG)
D = C	5	*LAT*	latitude	–90.00	90.00	0.01°N (□ $L_aL_aL_a$)

Location section (45 characters)

Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D = C	6	*LON*	longitude	–179.99	359.99	0.01°E ($L_oL_oL_oL_o$)
				0.00	359.99	(I-COADS convention)
				–179.99	180.00	(NCDC convention)
D	2	*IM*	IMMA version	0	99	(•65)
D	1	*ATTC*	attm count	0	9	
D = C	1	*TI*	time indicator	0	3	
D = C	1	*LI*	latitude/long. indic.	0	6	
D	1	*DS*	ship course	0	9	(D_s)
D	1	*VS*	ship speed	0	9	(v_s)
D	2	*NID*	national source indic.	0	99	
D = C	2	*II*	*ID* indicator	0	10	
D	9	*ID*	identification/call sign	c	c	(•42)
D	2	*C1*	country code	b	b	(•43)

Regular section (63 characters):

Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D = C	1	*DI*	wind direction indic.	0	6	
D = C	3	*D*	wind direction (true)	1	362	°, 361-2 (dd)
D = C	1	*WI*	wind speed indicator	0	8	(i_W)
D = C	3	*W*	wind speed	0	99.9	0.1 m s^{-1} (ff)
D = C	1	*VI*	*VV* indic.	0	2	(•9)
D	2	*VV*	visibility	90	99	(VV)
D	2	*WW*	present weather	0	99	(ww)
D	1	*W1*	past weather	0	9	(W_1)
D = C	5	*SLP*	sea level pressure	870.0	1074.6	0.1 hPa (PPPP)
D	1	*A*	characteristic of *PPP*	0	8	(a)
D	3	*PPP*	amt. pressure tend.	0	51.0	0.1 hPa (ppp)
D = C	1	*IT*	indic. for temperatures	0	9	(i_T)
D	4	*AT*	air temperature	–99.9	99.9	0.1°C (s_n, TTT)
D	1	*WBTI*	indic. for WBT	0	3	(s_w)
D	4	*WBT*	wet-bulb temperature	–99.9	99.9	0.1°C (s_w, $T_bT_bT_b$)
D	1	*DPTI*	*DPT* indic.	0	3	(s_t)
D	4	*DPT*	dew-point temp.	–99.9	99.9	0.1°C (s_t, $T_dT_dT_d$)
D = C	2	*SI*	*SST* meas. method	0	12	(•30)
D	4	*SST*	sea surface temp.	–99.9	99.9	0.1°C (s_n, $T_wT_wT_w$)
D	1	*N*	total cloud amount	0	9	(N)
D	1	*NH*	lower cloud amount	0	9	(N_h)
D	1	*CL*	low cloud type	0	9, “A”	(C_L)
D = C	1	*HI*	*H* indic.	0	1	(•9)
D	1	*H*	cloud height	0	9, “A”	(h)
D	1	*CM*	middle cloud type	0	9, “A”	(C_M)
D	1	*CH*	high cloud type	0	9, “A”	(C_H)
D	2	*WD*	wave direction	0	38	
D	2	*WP*	wave period	0	30, 99	seconds (P_WP_W)
D	2	*WH*	wave height	0	99	(H_WH_W)
D	2	*SD*	swell direction	0	38	($d_{W1}d_{W1}$)
D	2	*SP*	swell period	0	30, 99	seconds ($P_{W1}P_{W1}$)
D	2	*SH*	swell height	0	99	($H_{W1}H_{W1}$)

Table C1. I-COADS attm (column descriptions as for Table C0). 10° and 1° box numbers are available for sorting. The box system indicator is currently unused, but provides flexibility in case other box requirements arise (i.e., future extant values of BSI could indicate different contents in B10 and B1). Other fields in this attm are carried forward from LMR to ensure that all required LMR information maps into IMMA; LMR fields *IRD* and *A6* are obsolete and will be omitted from IMMA.

Doc.	Len.	Abbr.	Element description			
D	2	*ATTI*	attm ID			Note: set *ATTI*=1
D	2	*ATTL*	attm length			Note: set *ATTL*=65
Box elements (6 characters):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
C	1	*BSI*	box system indicator	u	u	(currently set to missing)
C	3	*B10*	10° box number	1	648	(I-COADS BOX10 system)
C	2	*B1*	1° box number	0	99	
I-COADS processing elements (17 characters):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
C	3	*DCK*	deck	0	999	
C	3	*SID*	source ID	0	999	
C	2	*PT*	platform type	0	15	
C	2	*DUPS*	dup status	0	14	
C	1	*DUPC*	dup check	0	2	
C	1	*TC*	track check	0	1	
C	1	*PB*	pressure bias	0	2	
C	1	*WX*	wave period indicator	1	1	
C	1	*SX*	swell period indicator	1	1	
C	2	*C2*	2nd country code	0	40	
I-COADS QC elements (38 characters):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
C	12	*	adaptive QC flags	1**	35**	6var.□2flag□1char.(base36)
C	1	*ND*	night/day flag	1	2	
C	6	*	trimming flags	1	15	base36
C	14	*	NCDC-QC flags	1	10	base36
C	2	*QCE*†	external (e.g., MEDS)	0	63	6 flags encoded in 2 char.
C	1	*LZ*	landlocked flag	1	1	
C	2	*QCZ*†	source exclusion flags	0	31	5 flags encoded in 2 char.

* The first letter of each QC flag indicates the applicable fields(s) (or if the QC applies to an entire report), according to the following general scheme (referring to field abbreviations from Table C1): *A*=*AT*, *B*=*VV*, *C*=clouds, *D*=*DPT*, *E*=wave, *F*=swell, *G*=*WBT*, *P*=*SLP*, *R*=relative humidity, *S*=*SST*, *T*=*A* and *PPP*, *U* or *V*=wind U- or V-component, *W*=wind, *X*=*WX*, *Y*=*W1*, Z=entire report. The lists of flag abbreviations are then:

- Adaptive QC flags: *SQZ*, *SQA*, *AQZ*, *AQA*, *UQZ*, *UQA*, *VQZ*, *VQA*, *PQZ*, *PQA*, *DQZ*, *DQA*.
- Trimming flags: *SF*, *AF*, *UF*, *VF*, *PF*, *RF*.
- NCDC-QC flags: *ZNC*, *WNC*, *BNC*, *XNC*, *YNC*, *PNC*, *ANC*, *GNC*, *DNC*, *SNC*, *CNC*, *ENC*, *FNC*, *TNC*.

** Table C7 provides further information about the adaptive QC flags.

† For the flags decoded from *QCE*, abbreviations are to be decided. Those from *QCZ* are: *SZ*, *AZ*, *WZ*, *PZ*, *RZ* (using the 1st-letter naming scheme described in the first footnote).

Table C2. IMMT-2/FM13 attm (column descriptions as for Table C0).

Doc.	Len.	Abbr.	Element description			
D	2	*ATTI*	attm ID			Note: set *ATTI*=2
D	2	*ATTL*	attm length			Note: set *ATTL*=76
Common for IMMT-2/-1 (52 characters):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D	1	*OS*	observation source	0	6	(•40)
D	1	*OP*	observation platform	0	9	(•41)
D	2	*FM*	FM code version	0	8	(•64)
D	1	*IX*	station/weather indic.	1	7	(i_X)
D	1	*W2*	2nd past weather	0	9	(W_2)
D	1	*SIGN*	sig. cloud amount	0	9	ref. *N*
D	1	*SIGT*	sig. cloud type	0	9, "A"	
D	2	*SIGH*	significant cloud ht.	0	99	(0-50, 56-99)
D	1	*WMI*	indic. for wave meas.	0	9	(•31)
D	2	*SD2*	dir. of second. swell	0	38	($d_{W2}d_{W2}$)
D	2	*SP2*	per. of second. swell	0	30, 99	($P_{W2}P_{W2}$)
D	2	*SH2*	ht. of second. swell	0	99	($H_{W2}H_{W2}$)
D	1	*IS*	ice accretion on ship	1	5	(I_s)
D	2	*ES*	thickness of I_s	0	99	cm (E_sE_s)
D	1	*RS*	rate of I_s	0	4	(R_s)
D	1	*IC1*	concentration of sea ice	0	9, "A"	(c_i)
D	1	*IC2*	stage of development	0	9, "A"	(S_i)
D	1	*IC3*	ice of land origin	0	9, "A"	(b_i)
D	1	*IC4*	true bearing ice edge	0	9, "A"	(D_i)
D	1	*IC5*	ice situation/trend	0	9, "A"	(z_i)
D	1	*IR*	indic. for precip. data	0	4	(i_R)
D	3	*RRR*	amount of precip.	0	999	(RRR)
D	1	*TR*	duration of per. *RRR*	1	9	(t_R)
D	1	*QCI*	quality control indic.	0	9	(•45)
D	1 20	*QI1-20*	QC indic. for fields	0	9	(Q_1-Q_{20})
New for IMMT-2 (20 characters):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D	1	*QI21*	MQCS version	0	9	(Q_{21})
D	3	*HDG*	ship's heading	0	360	° (HDG)
D	3	*COG*	course over ground	0	360	° (COG)
D	2	*SOG*	speed over ground	0	99	kt (SOG)
D	2	*SLL*	max.ht.>sum load ln.	0	99	m (SLL)
D	3	*SLHH*	dep. load ln.: sea lev.	-99	99	m ($s_L$hh)
D = C	3	*RWD*	relative wind dir.	1	362	°, 361-2 (ref. *D*)
D = C	3	*RWS*	relative wind speed	0	99.9	0.1 m s^{-1} (ref. *W*)

Table C3. Model quality control attm (column descriptions as for Table C0).

Doc.	Len.	Abbr.	Element description			
D	2	*ATTI*	attm ID			Note: set *ATTI*=3
D	2	*ATTL*	attm length			Note: set *ATTL*=66
GTS bulletin header fields (10 characters):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
UK	4	*CCCC*	collecting centre	a	a	
UK	6	*BUID*	bulletin ID	b	b	
UK model comparison elements (52 characters):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
UK	5	*BMP*	background (bckd.) *SLP*	870.0	1074.6	0.1 hPa
UK	4	*BSWU*	bckd. wind U comp.	−99.9	99.9	0.1 m s^{-1}
UK	4	*SWU*	derived wind U comp.	−99.9	99.9	0.1 m s^{-1}
UK	4	*BSWV*	bckd. wind V comp.	−99.9	99.9	0.1 m s^{-1}
UK	4	*SWV*	derived wind V comp.	−99.9	99.9	0.1 m s^{-1}
UK	4	*BSAT*	bckd. air temperature	−99.9	99.9	0.1°C
UK	3	*BSRH*	bckd. relative humidity	0	100	%
UK	3	*SRH*	derived relative humidity	0	100	%
UK	1	*SIX*	derived stn./weather indic.	2	3	(subset of i_X)
UK	4	*BSST*	bckd. *SST*	−99.9	99.9	0.1°C
UK	1	*MST*	model surface type	0	9	(UK 008204)
UK	3	*MSH*	model height of land sfc.	0	999	m
UK	4	*BY*	bckd. year	0	9999	year
UK	2	*BM*	bckd. month	1	12	month
UK	2	*BD*	bckd. day	1	31	day
UK	2	*BH*	bckd. hour	0	23	hour
UK	2	*BFL*	bckd. forecast length	0	99	hours

Table C4. Ship metadata attm (column descriptions as for Table C0). These fields are examples of the information available from WMO No. 47 (1955-) for 1973-94 (based on the metadata as uniformly reformatted by Elizabeth Kent for those years). As listed in the units column, some of the codes used for WMO No. 47 differed in form from the corresponding codes used in the observational data, such as *C1*, *OP*, and *SI*.

Doc.	Len.	Abbr.	Element description			
D	2	*ATTI*	attm ID			Note: set *ATTI*=4
D	2	*ATTL*	attm length			Note: set *ATTL=tbd*
Ship metadata elements (>14 characters):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D	2	*tbd*	country	u	u	3-digit code unlike *C1*
D	2	*tbd*	ship type	u	u	char. code unlike *OP*
D	1	*tbd*	barometer type	u	u	char. code
D	1	*tbd*	thermometer type	u	u	char. code
D	1	*tbd*	hygrometer type	u	u	char. code
D	1	*tbd*	*SST* method	u	u	char. code unlike *SI*
D	3	*tbd*	platform height	u	u	m
D	3	*tbd*	anemometer height	u	u	m
(plus additional elements to be decided)						

Table C5. Historical attm (column descriptions as for Table C0). *ATTI* is assigned, and *ATTL* to be decided (*tbd*).

Doc.	Len.	Abbr.	Element description			
D	2	*ATTI*	attm ID			Note: set *ATTI*=5
D	2	*ATTL*	attm length			Note: set *ATTL=tbd*
Historical data elements (> 19 characters):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D	1	*WFI*	*WF* indic.	u	u	
D	2	*WF*	wind force	0	12	
D	1	*XWI*	*XW* indic.	u	u	
D	3	*XW*	wind speed (ext. *W*)	0	99.9	0.1 m s^{-1}
D	1	*XDI*	*XD* indic.	u	u	
D	2	*XD*	wind dir. (ext. *D*)	u	u	
D	1	*SLPI*	*SLP* indic.	u	u	
D	1	*TAI*	*TA* indic.	u	u	
D	4	*TA*	*SLP* att. thermometer	–99.9	99.9	ref. *AT*
D	1	*XNI*	*XN* indic.	u	u	
D	2	*XN*	cloud amt. (ext. *N*)	u	u	
(plus additional elements to be decided)						

Table C6. Supplemental data attm (column descriptions as for Table C0). If *ATTL*=0 (unspecified length), this attm must appear at the end of the record, and the record terminate with a line feed. For the VOSClim record type, this attm will store the original input data string in ascii with *ATTL*=0 and *ATTE*=missing. (Note: if future requirements arise within the VOSClim record type, or for other record types, *ATTL* and *ATTE* can be adjusted accordingly).

Doc.	Len.	Abbr.	Element description			
D	2	*ATTI*	attm ID			Note: set *ATTI*=99
D	2	*ATTL*	attm length			Note: set *ATTL*=0
D	1	*ATTE*	attm encoding			Note: set *ATTE*=missing
Supplemental data (format determined nationally, or by data source):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
	ATTL	*SUPD*	supplemental data	c	c	

Table C7. A pair of adaptive QC flags is provided for each variable, ending in *Z* and *A* (e.g., *SQZ* and *SQA* for *SST*). These refer to the z* and alpha** values resulting from the comparison of the observation to the adaptive QC limits. If an observation is missing, or exceeds physical limits (e.g., for *SST*: outside the range −5.0°C to 40°C), the flags are set to missing. The technical details of the flag encoding/decoding (handled by the data access software) are described by this table.†

Value (flag		True value:	Units	Base	Coded:	
3rd letter):	Min.	Max.			Min.	Max.
z (*Z*)	−8.5σ	8.5σ	0.5	-18	1	35
alpha (*A*)	0.0	1.0	0.05	-1	1	21

* z: indicates the relationship of an individual observation to the adaptive standard deviation (σ) limits in 0.5σ steps. The extremes are open-ended in that any values < −8.5σ or > 8.5σ are mapped to ±8.5σ. Other σ values represent intervals of approximately ±0.25σ around the reported values because of rounding to the nearest 0.5σ. E.g., −3.5σ represents the approximate interval −3.75σ to −3.25σ.

** alpha: provides a measure of the reliability of the QC: it has a roughly inverse relationship with the number of observations available nearby (smaller alpha values indicate more data).

† A 2-stage encoding is applied: 1) The floating-point true value is divided by the "units" (the smallest increment of the data being encoded). Then the base is subtracted to produce, after rounding, a coded positive integer. 2) The integer is transformed into a base36 character. Decoding reverses this process by transforming the base36 value back into the coded value, and then the true value is reconstructed by:

true value = (coded + base) * units

Appendix D. Field Configurations

IMMA fields proposed for, or already subject to, international standardization are described here. These are ordered according to their appearance in Appendix C. Note: Appendix C also lists additional, nationally-defined fields, which are not described here.

The suggested field abbreviations are simple alphabetic strings (plus in some cases numeric suffixes), based generally on GTS symbolic letters (if defined) but without subscripts. These are listed in *UPPER-CASE*, for broad computer portability. As discussed in Appendix A, symbolic abbreviations already provide an important means of communication about the fields and data among Member countries and end-users. However, a transition away from subscripts is recommended to facilitate computerized implementation (e.g., headings for listings of the data).

The configurations of numeric fields were developed on the basis of representations that are readily input and output by computer software. Fields are right-justified within the specified field-widths (Appendix C), and to reduce data-volume decimal points are implicit (e.g., –99.9 is represented as –999). For signed numeric data, the plus sign ("+") is omitted, and the minus sign ("–") immediately prefixes the numeric portion (i.e., blank left-fill). These conventions have the advantage that numeric data can be readily input without separate steps to handle IMM sign positions (0=positive, 1=negative), and without parsing to ensure that a field does not contain non-numeric characters (e.g., "/").

In a delimited format, a universal missing value (e.g., -9999.99) could be selected outside the range of all data (except possibly for alphanumeric fields). In contrast, the fixed-field format contains different field-widths so a single numeric value is unworkable. A convention such as all nines filling each indicated field width doesn't work either, e.g., because many of the 1-character fields have extant numeric values covering the range 0-9.

Therefore, blanks are used as the universal representation for missing data. However, it is important to note that Fortran (by default) considers blanks to be equivalent to zero, thus to ensure correctness the processing must first parse a field as characters to ensure that it is not entirely blank. Machine-portable (e.g., Fortran and possibly C-language) software to help read the data is under development.

Some field configurations (e.g., for the historical attm) are undecided, and will benefit from future feedback and discussion (including possible additional options that are highlighted for some fields). In other cases existing LMR configurations are proposed. These provisional configurations may warrant modification or expansion after international consideration.

Location section

YR year UTC
MO month UTC
DY day UTC
HR hour UTC
As for IMMT-1, except *HR* (range: 00.00 to 23.99 UTC). Ship data typically are reported to whole hour, but the extended resolution is needed, e.g., for storage of drifting buoy data.

LAT latitude
LON longitude

Reversed in order from LMR. Position to hundredths of a degree +N or –S (measured north or south of the equator) and +E or −W (measured east or west of the Greenwich Meridian). Extended resolutions are needed, e.g., for storage of drifting buoy data. The longitude range (−179.99° to 359.99°) specified in Appendix C encompasses two distinct longitude conventions (0° to 359.99° and −179.99° to 180.00°), which are desirable for different applications and archival requirements (0° to 359.99° is strongly recommended for use, because it is the simplest formulation and thus helps to reduce the likelihood of location errors). Disallowing 360.00 and −180.00° ensures that meridians are uniquely represented within the convention range (i.e., avoiding: 0°/360.00°; 180.00°/−180.00°). However, even if IMMA records were stored in mixed conventions, all longitude values can be accurately interpreted because the overall range for longitude reserves negative for the western hemisphere. Note: organizing *YR*, *MO*, *DY*, *HR*, *LAT*, *LON* in sequence can facilitate synoptic sort operations.

> Options: Characters (N, S, E, W) could be used in place of sign for both latitude and longitude, but this complicates computer I/O and is therefore not recommended. Usage of quadrant or octant numbers also is not recommended, because a strictly numeric system is much more straightforward.

IM IMMA version
ATTC attm count

These fields are positioned near the front of the record to allow computerized input and interpretation (e.g., of different IMMA versions), but after *LON* so as not to interfere with sort operations. The proposed configuration is similar to "IMMT version":

0 = prototype version
1 = first internationally agreed version
2 = second internationally agreed version
etc.

ATTC provides the attm count:

0 = abbreviated record (no attm)
1 = one attm
2 = two attms
etc.

TI time indicator
LI latitude/longitude indicator

TI preserves the incoming precision of time fields:

0 = nearest whole hour
1 = hour to tenths
2 = hour plus minutes
3 = high resolution (e.g., hour to hundredths)

LI preserves the precision at which *LAT* and *LON* were recorded or translated from, or if they were derived later by interpolation between known positions:

0 = degrees and tenths
1 = whole degrees
2 = mixed precision
3 = interpolated
4 = degrees and minutes
5 = high resolution data (e.g., degrees to seconds)
6 = other

> [Note: This is a direct mapping from the LMR configuration, except that *LI*=2 is described there as "non random tenths" (a type of mixed precision; see p. F4 of Slutz et al., 1985).]

DS ship course
VS ship speed

WMO Codes 0700 and 4451 for contemporary data. A different code for *VS*, also with range 0-9, applied to data prior to 1 January 1968 (MetO, 1948):

0 = 0 knots	5 = 13-15 knots
1 = 1-3 knots	6 = 16-18 knots
2 = 4-6 knots	7 = 19-21 knots
3 = 7-9 knots	8 = 22-24 knots
4 = 10-12 knots	9 = over 24 knots

Beginning 1 January 1968 (Code 4451):

0 = 0 knots	5 = 21-25 knots
1 = 1-5 knots	6 = 26-30 knots
2 = 6-10 knots	7 = 31-35 knots
3 = 11-15 knots	8 = 36-40 knots
4 = 16-20 knots	9 = over 40 knots

As in LMR, it is proposed that both old and new *VS* codes be stored in the same field and differentiated by date (*DS* and *VS* are named *SC* and *SS* in LMR). Note: In IMMPC format documentation, Code 4451 may have been used to refer to both the old and new *VS* codes. Further research is needed to clarify the timing and details of this code change.

NID national source indicator

A field for national use in identifying data subsets.

[Note: For the VOSClim record type in the provisional format, this is set to 1 for ships that can be identified as part of the VOSClim Project, or missing otherwise.]

II *ID* indicator
ID identification/call sign

ID is extended to nine characters (versus seven in IMMT-2). In LMR, *II* indicates whether a call sign or some other sort of recognizable identification is contained in the *ID* field:

0 = ID present, but unknown type
1 = ship, Ocean Station Vessel (OSV), or ice station call sign
2 = generic ID (e.g., SHIP, BUOY, RIGG, PLAT)
3 = WMO 5-digit buoy number
4 = other buoy number (e.g., Argos or national buoy number)
5 = Coastal-Marine Automated Network (C-MAN) ID (US NDBC operated)
6 = station name or number
7 = oceanographic platform/cruise number
8 = fishing vessel psuedo-ID
9 = national ship number
10 = composite information from early ship data

C1 country code

The country that recruited a ship, which may differ from the country of immediate receipt (field *C2* in Appendix C) and may also differ from the ship's registry. Numeric code values 00-40 were documented by WMO, which transitioned to 2-character ISO alphabetic codes effective 1 January 1998. We envision storage of the numeric codes for historical data, or of the alphabetic codes for recent data, in this field (since, e.g., the old numeric codes include the USSR and other countries no longer named as such by ISO).

Regular section

DI wind direction indicator

D wind direction

DI gives the compass (and approximate precision) used for reporting the wind direction (in LMR, directions are mapped to degrees according to Table 8 of the LMR documentation):

0 = 36-point compass
1 = 32-point compass
2 = 16 of 36-point compass
3 = 16 of 32-point compass
4 = 8-point compass
5 = 360-point compass
6 = high resolution data (e.g., tenths of degrees)

D is the direction (true) from which wind is blowing, stored in whole degrees (i.e., 360-point compass; range: 1-360°), or special codes:

361 = calm
362 = variable

Options: Alternatively, 0 could be used for calm (00 is used in IMMT-2). Similarly, a value such as 999 could be used for variable (99 is used in IMMT-2, but 99 indicates 99° here). However, an unambiguous and numerically closed range (1-362, rather than 0-360, 999) is also advantageous for computational reasons (e.g., range checking).

WI wind speed indicator
W wind speed

Wind speed is stored in tenths of a meter per second (to retain adequate precision for winds converted from knots, or high-resolution data). *WI* shows the units in which and/or the method by which *W* was originally recorded (0, 1, 3, 4 follow WMO code 1855):

0 = meter per second, estimated
1 = meter per second, measured
2 = estimated (original units unknown)
3 = knot, estimated
4 = knot, measured
5 = Beaufort force (based on documentation)
6 = estimated (original units unknown)/unknown method
7 = measured (original units unknown)
8 = high-resolution measurement (e.g., hundredths of a meter per second)

For reports derived from, e.g., TDF-11 format, the meaning of *WI*=6 is either "estimated (units unknown)," or "both method and units unknown" (i.e., the indicator was missing). This unfortunate ambiguity derives from the dual meaning present in some original archive formats, including IMMPC (ref. Appendix B).

VI visibility indicator
VV visibility

The "Cloud height and visibility measuring indicator" from IMMT-2 is separated into independent indicators *H* and *VV*. *VI* shows whether *VV* was:

0 = estimated (or unknown method of observation)
1 = measured
2 = fog present

The "fog present" value is not defined in IMMT-2, but stems from early IMMPC definitions (see Appendix B).

WW present weather
W1 past weather

WMO Codes 4677 and 4561. For use of weather data after 1982, refer to *IX*.

SLP sea level pressure
A barometric tendency
PPP amount of SLP change

SLP and *PPP* in tenths of hPa (i.e., millibars), and *A* according to WMO Code 0200. IMMT-2 contains a 4-character (PPPP) representation of *SLP* in IMMT-2 (dropping the leading digit).

IT indicator for temperatures
AT air temperature (i.e., dry bulb)
WBTI *WBT* indicator
WBT wet bulb temperature
DPTI *DPT* indicator
DPT dew point temperature
SI *SST* method indicator
SST sea surface temperature

Temperatures are stored in tenths of a degree Celsius. *IT* provides information about the precision and/or units that the temperature elements were translated from (0-2 match i_T=3-5 in IMMT-2; the full configuration matches *T1* in LMR):

0 = tenths °C
1 = half °C
2 = whole °C
3 = whole or tenths °C (mixed precision among temperature fields)
4 = tenths °F
5 = half °F
6 = whole °F
7 = whole or tenths °F (mixed precision among temperature fields)
8 = high resolution data (e.g., hundredths °C)
9 = other

[Note: Early historical temperatures were also reported in degrees Réaumur, or mixed units. Additional fields may be desirable in the historical attm to record these details.]

WBTI and *DPTI* indicate which of *WBT* or *DPT* was measured or computed, and ice bulb conditions (derived from sign positions s_t and s_w in IMMT-2):

0 = measured
1 = computed
2 = iced measured
3 = iced computed

[Note: For data translated e.g. from IMMT-2 format, *T2* from LMR provides a subset of information derived from s_t and s_w, plus information about whether *DPT* was computed during I-COADS processing (such that for data translated from LMR to IMMA, we set *DPTI*=1 or 3). Future work should seek to recover more complete information from original formats, and consider new configurations to separately document I-COADS processing.]

SI shows the method by which *SST* was taken (0-7 follow the IMMT-2 code):

0 = bucket
1 = condenser inlet (intake)
2 = trailing thermistor
3 = hull contact sensor
4 = through hull sensor
5 = radiation thermometer
6 = bait tanks thermometer
7 = others

9 = unknown or non-bucket
10 = "implied" bucket [Note: applicable to early I-COADS data.]
11 = reversing thermometer or mechanical sensor
12 = electronic sensor

[Note: Except for omitting *SI*=8 ("unknown"), an unintended setting applicable only to decks 705-705), this is a direct mapping from the LMR configuration. In translation from LMR, *SI*=8 is made missing.]

N total cloud amount
NH lower cloud amount
CL low cloud type
HI cloud height indicator
H cloud height
CM middle cloud type
CH high cloud type

Configurations as in IMMT-2, except for use of "A" (10 in base36) in place of "/" (LMR also uses 10 in place of "/"), with ordering of *N*,…,*CH* as in LMR. The "Cloud height and visibility measuring indicator" from IMMT-2 is separated into independent indicators *H* and *VV*. *HI* (not presently part of the GTS SHIP code) shows if cloud height *H* was:

0 = estimated
1 = measured

WD wave direction
WP wave period
WH wave height

Historically, the (wind) wave and swell fields have been subject to complicated code changes. Both the wave and swell fields were reported in descriptive terms according to the SHIP code, and thus are expected to be missing, prior to 1949 (and the swell fields are expected to be missing prior to 1 July 1963, as discussed below). *WD* codes 00 to 36 (WMO Code 0877) show the direction (if any) from which (wind) waves come, in tens of degrees (e.g., 00 = calm, 01 = 005°-014°,…, 36 = 355°-004°). Codes 37-38 (99 in WMO Code 0877) show "waves confused, direction indeterminate" under *WH* conditions explained in the LMR documentation. Starting in 1968, *WD* was no longer reported and *WP* was reported in seconds. Prior to 1968, period was reported as a code, which was converted into whole seconds per Table 10 of the LMR documentation, with *WX* (ref. Table C1) set accordingly. *WH* is wave height in 1/2 meter increments, i.e., 1=0.5 m, 2=1 m, etc.

[Note: *WP*=99, indicating a confused sea, is not presently defined in LMR. Future work should seek to recover this information from original formats.]

SD swell direction
SP swell period
SH swell height

Configurations similar to the corresponding wave fields *WD*, *WP*, and *WH*. Beginning 1 July 1963 both sea (i.e., wind wave) and swell were reported. Prior to that date only the higher of sea and swell was reported. Starting in 1982, *SP* was reported in seconds. Prior to 1968 (1982), *SP* was reported as a code, which was converted into whole seconds per Table 10 (Table 11) of the LMR documentation, with *SX* (ref. Table C1) set accordingly.

Attm control

ATTI attm ID
ATTL attm length
ATTE attm data encoding

Each attm begins with *ATTI* and *ATTL*. *ATTI* identifies the attm contents, and *ATTL* provides the total length of the attm (including *ATTI* and *ATTL*) in bytes, or zero for length unspecified (record terminated by a line feed; line feed not counted as part of *ATTL*). The supplementary data attm (ref. Table C6) also includes *ATTE*, which indicates whether the supplementary data that follow are in ascii or encoded:

missing = ascii
0 = base64 encoding

The software under development to read IMMA will make some tests to determine if each individual IMMA record is properly configured, including checking *ATTC* (ref. Table C0) against the number of attachments present. It will require that duplicate attms (i.e., two attms with the same *ATTI*) not appear in a record. The software will not require that attachments appear in any particular order by *ATTI*, with one exception: the supplementary data attm must be the final attm within the record if *ATTL*=0.

IMMT-2/FM13 attm

OS observation source
OP observation platform
As defined in IMMT-2.

FM FM code version
For *FM*, the corresponding field in IMMT-2 ranges from 0-8, but is extended here to two characters to allow room for expansion.

IX station/weather indicator
W2 second past weather
IX (WMO Code 1860) indicates both whether the station is manned or automatic, and the status of present and past weather data. *IX* is vital for proper interpretation of weather data starting in 1982; see LMR documentation for a detailed discussion, including unforeseen complications that attended its introduction (with *W2*; WMO Code 4561) in 1982 (e.g., *IX* was not included in IMMT until March 1985).

SIGN significant cloud amount
SIGT significant cloud type
SIGH significant cloud height
Use of "A" (10 in base36) in place of "/." The significant cloud fields are listed in MetO (1948), but they were omitted from the IMM formats. Allocation of space for these is tentatively provided, but it is not clear how widely available they would be in logbook data or existing digital archives.

WMI indicator for wave measurement
WMI is the IMMT-2 "indicator for wave measurement" (shipborne wave recorder, buoy, or other measurement systems).

SD2 swell direction (2nd)
SP2 swell period (2nd)
SH2 swell height (2nd)
As defined for IMMT-2 (configurations as for *SD*, *SP*, and *SH*).

IS ice accretion
ES ice thickness
RS ice accretion rate
Fields for ice accretion on the ship, as defined for IMMT-2.

IC1 concentration of sea ice
IC2 stage of development
IC3 ice of land origin
IC4 true bearing ice edge
IC5 ice situation/trend

Configurations as in IMMT-2, except for use of "A" (10 in base36) in place of "/." These are not presently included among LMR regular fields. The fields changed dramatically in 1982 (field descriptions reflect the 1982 Codes):

pre-1982	starting 1 Jan. 1982
description of ice type	concentration of ice (WMO Code 0639)
effect of ice on navigation	stage of ice development (WMO Code 3739)
bearing of principal ice edge	ice of land origin (WMO Code 0439)
distance to ice edge	true bearing principal ice edge (WMO Code 0739)
orientation of ice edge	ice situation/trend (WMO Code 5239)

Options: TD-1129 simply stores the old/new information as listed above in the same field, thus making it critical that users be aware of the code change. Either this approach could be used, or separate fields (or an indicator field) could be considered. Earlier historical ice codes might also need to be researched for possible consideration. MetO (1948) lists an Ice Group (c_2KD_ire) that may be similar or identical to the above pre-1982 code (see also Table B3 of Appendix B).

IR indicator for precipitation data
RRR amount of precipitation
TR duration of period of reference for amount of precipitation

As defined for IMMT-2. The precipitation fields are not presently included among regular LMR fields.

QCI quality control (QC) indicator
QI1-21 QC indicators for fields

Field *QCI* provides general information about the level of manual or automated QC that has been applied to the data. Twenty *QI* indicators for individual fields or field groups are included in IMMT-2 and IMMT-1 (see Table B2 of Appendix B), whereas 18 were included in the 1982 IMMT format, and none were available in IMMPC. IMMT-2 adds a 21st element to document the QC version.

HDG ship's (bow) heading in degrees (referenced to true North)
COG course over ground (reference to true North)
SOG speed over ground (the speed at which the vessel moves over the fixed earth)
SLL max. height (m) of deck cargo above summer max. load line
SLHH departure of summer max. load line from actual sea level

Fields added to IMMT-2 for VOSClim.

RWD relative wind direction
RWS relative wind speed

Fields added to IMMT-2 for VOSClim.

Historical attm

WFI wind force indicator
WF wind force
XWI *XW* indicator
XW wind speed (extension field for *W*)
XDI *XD* indicator

XD wind direction code (extension field for *D*)

WFI and *WF* are intended primarily for 0-12 Beaufort wind force codes, but potentially could be extended to other 2- or 1-digit codes, with *WFI* indicating the type of information, e.g.: 0-6 (half Beaufort code in 19th century Norwegian logbooks), Ben Nevis Observatory code. *XWI* and *XW* are intended for equivalent wind speed, with *XWI* indicating the scale used to convert from *WF* (e.g., the existing WMO Code 1100 scale or newer alternatives). Similarly, fields *XDI* and *XD* are intended for older 2- or 1-digit wind direction codes, with *XDI* indicating the type of information, e.g.: 32-, 16-, or 8-point compasses.

SLPI *SLP* indicator

TAI *TA* indicator

TA *SLP* attached thermometer

SLPI is intended for historical data to indicate the barometer type (e.g., mercurial, aneroid, or metal). *TAI* (configuration undecided, but probably similar to some of the other temperature indicators) and *TA* are proposed for older mercurial barometer data, in which the attached thermometer is critical for data adjustments.

XNI *XN* indicator

XN cloud amount (extended field for *N*)

XN is intended for historical cloud amount data (e.g., in tenths), with *XNI* indicating the units (e.g., tenths).